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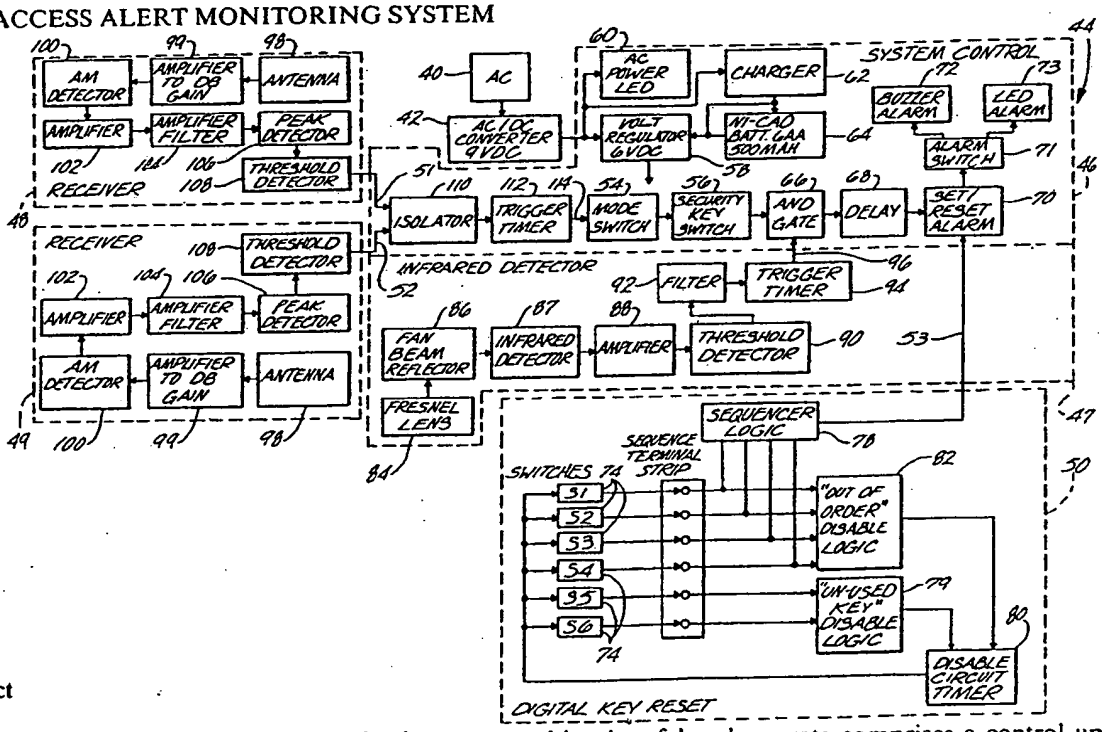

(57) Abstract

A multi spectrum access control monitoring system with a low false alarm rate comprises a control unit (18) disposed above each guarded passageway in a controlled space. The control unit (18) includes a passive infrared detector (47) having a source of infrared energy to produce a narrow infrared fan beam (20) or "screen" across the passageway. The infrared screen (20) senses heat from the body of a person passing through the passageway, and an electrical control signal (96) is generated in response to passage of any person through the screen. Small portable RF transmitters (22) are carried by persons in a first group whose whereabouts are monitored. Persons in a second group to be monitored do not carry the transmitter units (22). The control unit (18) also includes an RF receiver (32) tuned to detect an identification signal generated by the portable transmitters (22).

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ACCESS ALERT MONITORING SYSTEM

Field of the Invention

This invention relates to monitoring systems for detecting the movement of certain selected persons occupying a controlled space. The invention is particularly useful in institutions such as hospitals and convalescent homes for monitoring the whereabouts of patients or individuals with certain physical impairments. The invention is also useful in business establishments such as offices for controlling security at certain restricted access locations within the building.

Background of the Invention

There is a need to control the access of people in certain areas, for instance in hospitals to control the movements of patients, or in convalescent homes or mental institutions where the memory of individuals is impaired and it is necessary to deny access of these individuals to certain outside uncontrolled areas. It is often desirable to restrict these individuals to a particular room in a facility. The purpose is to prevent putting themselves into possibly harmful situations.

In the past, various electronic monitoring or security systems have been developed to provide limited access control functions. Some of these systems are as simple as an alarm system which alarms when a person passes through a doorway or passageway. An example is a monitoring system using magnetic tags attached to various articles, such as in bookstores, libraries and department stores where the tags are detected if the articles are moved past a sensor. Such systems are well known for reducing pilferage or shop-lifting.

Other monitoring systems may include an electronic system composed of radio frequency (RF) or microwave transmitter/receiver sensors, sonic/ultrasonic/low frequency sensors, optical (passive or active) laser/infrared/visible light sensors, or simple switch mats.

In order to be more selective as to which person is passing through a doorway or passageway, an identifying sensor attached to a controlled individual can be detected to identify that particular person's movement within the controlled area. The following U.S. patents disclose a variety of security systems for monitoring the movement of certain individuals: 3,839,709- Sugiura; 3,928,843 - Sprout et al.; 4,136,338- Antenore; 4,195,286 - Galvin; 4,447,726 - Mudge et al.; 4,593,273 - Narcisse; and 4,598,275 - Ross et al.

An electronic monitoring system can have RF/microwave transmitter/receiver sensors where the transmitter or diode multiplier is attached to the controlled individual; sonic/ultrasonic/low frequency systems where the transmitter or resonant circuit is attached to the controlled individual; or magnetic sensors where a magnetic tag is attached to the controlled individual. All of these systems require fine tuning and have a false alarm rate. These types of

sensors are not sufficiently reliable for use in a monitoring system for controlling movements of individuals through guarded passageways or doorways in a controlled facility. A false alarm can occur when an individual with an attached sensor does not enter a doorway or passageway but does come into close proximity and causes an alarm or positive sensor detection. An example of this could occur when the controlled individual is walking down a hallway adjacent to where electronic detectors are in operation.

Further, some monitoring systems consume transmitter battery power which is greater than desirable. The transmitter life is thus too short, and in some cases disposable transmitters are used which result in high operating costs.

Some prior art security systems also are confined to specific modes of operation for alarming. It is desirable for a monitoring system to be capable of operating reliably in various modes of operation that can be pre-set depending upon the particular security need.

The present invention provides an access control monitoring system having a low false alarm rate. In addition, the system has a multi-mode operating function which can meet changing and varied requirements for monitoring the movements of select individuals or providing total security within a controlled area. In one embodiment, the invention can be a physical security barrier to detect specially implanted sensors in articles as well as providing a security system to protect the passage of any person. In addition, transmitter battery power consumption is reduced, and the system can be implemented at a reasonably low cost.

Summary of the Invention

Briefly, this invention provides a multi-spectrum access alert monitoring system for detecting and identifying when a selected person from among a group of persons has passed through a guarded passageway in a controlled space. One embodiment of the system includes an infrared detector for producing a narrow field of infrared energy across the volume within the guarded passageway. The detector produces an invisible energy screen across the plane of the doorway or passageway so that it is impossible to pass through without being detected. A first control signal is produced in response to detection of a person passing through the detection screen. A portable transmitter unit for generating an identification signal is carried by a selected person or a selected group of persons whose passage through the guarded passageway is to be controlled. A different person or persons within a second group of controlled individuals do not carry the portable transmitter unit. A receiver is placed adjacent the guarded passageway for detecting the identification from the transmitter unit signal and producing a second control signal when a person carrying the transmitter unit is in proximity to the guarded passageway. An access control unit associated with the passageway processes the first and second control signals to generate our alarm signal when a preselected person whose movements are to be monitored passes the guarded passageway. The control unit produces a first indication of controlled passage through the guarded passageway in response to simultaneous detection of the first and second control signals, while producing a second indication of control passage through the guarded passageway in response to the first control signal being generated by a person not carrying the transmitter unit.

In one embodiment, the persons whose whereabouts are to be carefully controlled, such as patients in a hospital or convalescent home, carry the transmitter unit, whereas other personnel, such as staff workers, visitors and vendors, do not carry the transmitter unit. In this instance, the first indication of controlled passage produces an alarm to indicate when the patient is detected by the detector screen and the identification signal from the transmitter is simultaneously detected by the receiver. The second indication of controlled passage is implemented by not producing an alarm signal when other individuals having free access through the guarded doorways and passageways are detected by the detector screen. In an alternative mode of operation, individuals having free access to doorways and passageways can carry the transmitter unit and the controlled individuals do not carry the transmitter. In this instance, the alarm signal is generated when a person not having the transmitter bypasses the detector screen.

System reliability is enhanced by the multi-spectrum combination of the infrared field at the guarded passageway and the transmitter/receiver system for discriminating between whether or not the person passing through the infrared field is permitted in that area or not. In addition, the mode of operation can be easily preset so that the alarm signal is generated either by persons carrying the identifying transmitter, or by persons without the identifying transmitter passing through the infrared field in the guarded passageway. The system also can be adjusted to provided a total security system to deny access to all persons regardless of whether they carry an identifying transmitter or not. Thus, in addition to providing a highly reliable monitoring system essentially free of

false alarms, the system also can be adjusted to provide various modes of operation so that the system can be easily converted from one type of control to another depending upon the security need.

These and other aspects of the invention will be more fully understood by referring to the following detailed description and the accompanying drawings.

Brief Description of the Drawings

FIG. 1 is a fragmentary semi-schematic perspective view illustrating implementation of an access alert monitoring system, according to principles of this invention, in a hospital or convalescent home environment.

FIG. 2 is a schematic view illustrating one embodiment of the installation of components of the access alert monitoring system at a doorway.

FIG. 3 is a functional block diagram illustrating components of the primary access alert subassembly components of the monitoring system.

FIG. 4 is a functional block diagram illustrating components of a transmitter used in conjunction with the system shown in FIG. 3.

Detailed Description

FIG. 1 schematically illustrates components of a multi-spectrum access alert monitoring system according to principles of this invention. FIG. 2 schematically illustrates implementation of system components adjacent a guarded passageway in a facility in which the monitoring system is used. Referring to FIG. 1, a hospital or convalescent home 10 has a wall 12 forming a portion of a hallway 14 which bypasses a guarded doorway 16. If a controlled individual passes through the doorway, an alarm is activated. Although the figure depicts use of the invention in a hospital or convalescent home facility, the invention also can be used in other buildings or offices within which access by different persons is monitored and controlled. Passage of persons through the doorway 16 is monitored by the access alert monitoring system of this invention which includes a control unit 18 mounted above the doorway. Details of the control unit are described in more detail below. Although the figure depicts use of the invention to control access of persons through the doorway, the invention also can be used to monitor and control movements of persons through any passageway such as the hallway 14.

The control unit 18 produces an invisible access detection screen 20 across the opening in the doorway 16.

The access detection screen is one of two types of sensors used in this invention to make a decision on whether a detected individual should activate the system alarm. The detection screen is produced by energy capable of detecting the presence of a person in the doorway. The screen has a very limited field of view and is preferably a narrow screen that occupies the volume within the doorway so that it is impossible for a

person passing through the doorway to be detected by the detection screen. In a preferred embodiment, the detection screen is produced by a narrow fan beam of infrared energy.

The infrared screen is preferably produced by a passive infrared detector with a window or filter which maximizes its effectiveness in detecting heat emitted from the human body. A lens subsystem in the control unit includes a Fresnel lens with two reflectors to produce a converged pattern or region of infrared energy similar to a fan beam. The fan beam is directed downwardly from above the doorway, across the opening through the doorway 16. The infrared field occupies a narrow volume within the doorway in the sense that the infrared screen is narrow in the plane perpendicular to the opening in the doorway and is wider in the plane of the doorway so as to cover a substantial portion of the projected area within the doorway. The screen is effective so that it will detect heat from the body of any person passing through the doorway.

The monitoring system also includes a portable control access transmitter unit to be carried by each of a plurality of persons in a first group of individuals whose movements within the controlled area are to be monitored. Such a transmitter unit is not carried by any of the individuals in a second group of persons whose movements are to be monitored. A "controlled individual" is any person within a group of persons whose whereabouts are controlled by the monitoring system so that they are denied access or passage through a guarded doorway or passageway. The controlled individuals may be in the first group (those who carry the transmitter unit) or, alternately, in the second group (those who do not carry the transmitter unit). In the embodiment illustrated in FIG. 1, the transmitter

unit 22 is carried by a nurse in the facility who has free access to all open spaces within the facility linked by the passageways or doorways guarded by the access alert monitoring system. In this instance, a patient 24 confined to a hospital room or the like would not carry the transmitter unit 22 and the alarm would be activated only if the patient passed through the guarded doorway 16. This mode of operation of the monitoring control system is illustrated in FIG. 1 as an example only inasmuch as other modes of operation are possible, and will be described in more detail below. The system shown in FIG. 1 also may include a remote monitoring station 26 having a remote alarm 28 activated when the control unit alarm 30 is activated by passage of a controlled individual whose whereabouts are being monitored.

FIG. 2 schematically illustrates further components of the access alert monitoring system. In this embodiment, the control unit 18 is shown mounted above the doorway with the audio or visual alarm 30 to be activated by passage of a controlled individual. The control unit also has an infrared energy source 32 which produces the invisible infrared access detection screen 20. A pair of receivers 32 are positioned adjacent opposite sides of the doorway 16 for receiving any identification signal transmitted by the transmitter units. The receivers and transmitters are operated on a different energy spectrum from the access detection screen. In a preferred embodiment, the receivers are radio frequency (RF) receivers to receive a low range RF signal from the transmitter units. The receivers are positioned adjacent to doorway so that they will most effectively receive RF signals transmitted by the transmitter unit 22 from persons carrying the transmitter units. Each receiver is connected to an

electronic control system in the control unit through separate conductors 34 leading from the receiver to the control unit. A digital reset lock 36 positioned adjacent the passageway is connected to the control system in the control unit. A set of switch pads 38 on the reset lock are activated to produce coded input signals for resetting the control unit after the alarm has been activated, to place the control unit back in its ready mode of operation.

In order to better understand the operation of the access alert monitoring system from the description to follow, the system will first be described generally in relation to the various modes of operation provided by the system. The system has a low false-alarm rate and therefore high operating reliability owing to the access control system operating from a multi-spectrum set of input control signals, one produced by activation of the invisible infrared access detection screen and the other produced by detection of an RF signal from a transmitter unit. This system determines whether there is anyone in the doorway or passageway from detection by the infrared screen and then determines whether the person detected by the infrared screen has an attached RF sensor. Input signals generated by these two diverse spectrum-related functions are implemented in several modes of alarming as follows:

(1) Admit Mode. This mode allows anybody without an attached transmitter unit to pass or to be admitted through a doorway or passageway without activating the alarm. If a person has an attached transmitter, or if a pilferable item is implanted with the transmitter, then the system will alarm and thus deny access. As an example, in a convalescent home environment, wandering patients wearing a transmitter can be controlled by the access control alarm, thus alerting the nurses and staff

of a denied access condition. The staff, visitors, vendors, and the like, would have free access through the doorways or passageways inasmuch as they would not carry the transmitter unit.

(2) Reject Mode. This mode will activate the alarm and thus deny or reject access to any person without an attached transmitter who tries to pass through the protected doorway or passageway. If a person has an attached transmitter, then the system does not alarm. In this mode, in a convalescent home environment, only patients do not have an attached transmitter and would be controlled by the system alarm that alerts the nurses and staff of a denied access. All other personnel, including all staff, visitors, vendors, and the like would be required to carry an attached transmitter in order to have free passage.

(3) Security Mode. This mode denies access passage to all persons regardless of whether they have an attached sensor or not. This mode is useful in safeguarding doorways or passageways that lead to the exterior of the facility. The alarm can be activated at the discretion of the administrators or by an automatic timer.

As a brief summary of the preferred access alert monitoring system, the system first determines whether anyone is in the doorway or passageway via detection by the infrared access detection screen 20. If a person passes through the infrared detection screen, a first control signal is generated and sent to a system control section of the controller to indicate passage of a person through the doorway. The RF transmitter-receiver system produces a second control signal sent to the system control section of the controller to indicate that the person passing through the infrared screen is carrying the transmitter unit 22. Depending upon the

mode of operation, these two control signals can be used to either activate the alarm (alert mode) or not activate the alarm (reject mode). In a preferred embodiment, the RF transmitter produces a low range pulsed AM signal, preferably at a frequency of about 480 kHz. At this frequency, several advantages are obtained. The propagation of this frequency is not perturbed very much due to human body absorption. The antenna is fabricated from ferrite rod devices that meet the size constraint of an access control system. The battery life (approximately six months of continuous operation) of the transmitter is extended by using zinc-air hearing aid batteries that are small and inexpensive. The transmitter has very small components and is amenable to small-size requirements of the access control system. The RF transmitter-receiver link operates at a low duty cycle 480 kHz signal with a pulse repetition rate of approximately 700 Hz. This transmitter consumes very low average power from the transmitter battery and thus, contributes to long battery lifetimes. The receiver is a direct detected amplitude type with no local oscillator and thus does not radiate or require FCC emission approval. A high Q tuned circuit provides the selectivity along with a bandpass filter following the amplitude detector. A peak detector threshold is adjusted to determine the receiver sensitivity. In one embodiment, the low power output from the transmitter is received by the receiver over a maximum range of about two feet.

As mentioned above, the system is installed with the control unit above the doorway or passageway so that the passive infrared beam is aimed downwardly toward the floor. The logic and control electronics are contained in the control unit. The two 480 kHz receivers mounted on each side of the doorway are connected to the control

unit as described previously. The control unit is powered by AC current with DC batteries as a back-up. The transmitters are attached to the wrist or ankle or waist by some means which does not allow the patient or other user to remove it. If attached to staff personnel, visitors or vendors, the transmitter can be in the form of an identification badge. For implementation into a pilferable item, a derivative of either would suffice.

Although the alarm can be reset in various ways, it is preferred that the reset function be carried out only by staff personnel using a selected digital code sequence input to the reset lock. Alternatively, an automatic reset could be used after a set amount of time after the alarm is activated.

FIG. 3 is a functional block diagram of the primary components of the access alert monitoring system. This assembly of components uses an alternating current (AC) source 40 as a primary power source. An AC to direct current (DC) converter 42 supplies 9 volts to a control assembly 44 comprised of a system control section 46 and an infrared detector section 47. Attached to the control assembly are three sub-assemblies with include two receiver sections 48 and 49 and a digital key reset section 50. These sub-assemblies are attached via cabling harnesses 51, 52 and 53. The system control section 46 provides the decision logic on valid receiver signals from the RF receiver section 48 and 49 and on a simultaneously received valid signal from the infrared detector section 53. The system control section also allows for selection of two operating modes by the mode switch 54, in which operation is selected in either the admit mode or reject mode described above. The security mode selection can be made by activating a security key

switch 56 which overrides the mode selected by the mode switch to operate exclusively in the security mode.

The system control section 46 includes a voltage regulator 58 to provide voltage regulation of about 5 volts for the entire assembly. An AC power indicator light-emitting-diode (LED) 60 provides visual indication of AC power on. A charging circuit 62 allows constant trickle charging of six nicad batteries 64, so that automatic power back-up is achieved through the voltage regulator 58.

The alarm activation is controlled by an "AND" gate 66 and is then delayed by a delay timer 68 to minimize false alarms before setting an alarm 70. When alarmed, an alarm switch 71 activates an alarm buzzer 72 and an LED alarm 73. The alarm continues until reset alarm 70 receives a valid signal from the digital key reset section 50.

The digital key reset section allows for a sequence of numerals to be entered by input switches 74 and coded by a terminal strip 76, so that a four-digit code, when properly entered, is decoded as a valid response by a sequence logic circuit 78 and passed via the wiring harness 53 to the alarm reset 70. If an unused key of the switches 74 is entered at any time, a disable logic circuit 79 signals a disable circuit timer 80 and all the keys are disabled for about three seconds. If coded keys are entered out of sequence, a disable logic circuit 82 signals the disable circuit timer 80 which again disables all of the keys for about three seconds. The sequence code is set by wiring the terminal strip 76 in a desired sequence.

The infrared detector section 47 receives infrared energy through a focusing lens, preferably a Fresnel lens 84. A fan beam is produced by two reflectors 86 and the infrared energy is transformed to an electrical

signal by a pyroelectric detector 87 and then amplified by an amplifier 88. A threshold detector 90 receives the amplified output from the amplifier and passes it to a filter 92 in order to minimize false alarms. The output from the filter passes to a triggered timer 94, which produces a control output signal 96 sent to the AND gate 66. The control signal 96 from the infrared detector represents a valid infrared detection signal for the AND gate logic in the system control section. When this control signal is generated, it indicates that a person has entered the narrow fan beam of the infrared detector and additional control steps within the system control section are then carried out, depending upon the selected mode.

The system includes two identical receiver sections 48 and 49. Each receiver receives a low-pulse repetition frequency and low-duty cycle RF signal from a transmitter described in FIG. 4. The RF energy enters a tuned ferrite rod antenna 98, and then is amplified by an amplifier 99, and then detected by an AM detector 100. The detected envelope is amplified by an amplifier 102 and then filtered by an amplifier filter 104 to minimize false alarms. The signal from the filter is then peak-detected at 106 and threshold-detected at 108 to set the signal sensitivity of the receiver to preferably 480 kHz. Signals above the threshold are directed via the wiring harnesses 51 and 52 to the system control section. The sensitivity of the receiver is low to minimize interference and yet be reliable for short distances. For this reason, the two receivers are mounted on each side of a doorway or passageway to be monitored. A signal can be received by either or both receivers, and these signals are isolated by an isolator circuit 110 to prevent interference with each other. A valid detected RF signal then activates a trigger/timer

112 to produce an output control signal 114 indicating that the receiver section has validly received an RF signal transmitted by the transmitter unit.

The mode switch 54 provides the logic of alarming if a valid receiver signal and a valid infrared signal, i.e., the signals 114 and 96, respectively, are received simultaneously; or if no receiver signal and a valid infrared signal occur simultaneously.

The security key switch 56 provides an override to put the system in the security mode and produce an alarm signal when a valid infrared signal occurs, regardless of the receiver condition.

FIG. 4 illustrates the functional block diagram of the transmitter unit 22. This transmitter is powered by a single button battery 116, preferably a 1.4 volt battery. To achieve low battery consumption, a low duty cycle, low-pulse repetition frequency waveform is generated by a capacitor charging circuit 118. This turns on and off a one-transistor oscillator 120. The RF frequency is determined by the antenna tuned circuit 122, which is a ferrite-type antenna.

Thus, the system provides a low false alarm rate owing to the narrow infrared access detection screen being used to detect passage of an individual through the guarded passageway in combination with the RF transmitter-receiver system and the associated control logic which then detects whether or not the person passing through the screen is authorized to gain access. In addition, the alarm mode can be adjusted to meet varied security requirements. Further, transmitter life is extended and the cost of implementing the system is reasonably low.

WHAT IS CLAIMED IS:

1. An access alert monitoring system for detecting and identifying when a selected person, from among a group of persons, has passed through a guarded passageway in a controlled space, the system comprising:

means for producing a narrow field of infrared energy across the width of the guarded passageway;

means for producing a first electrical control signal when the body of a person passing into said infrared energy field is detected;

a portable transmitter adapted to be carried by a selected person for emitting an identification signal;

receiver means adapted for mounting adjacent the passageway for detecting the identification signal and producing a second electrical control signal when the selected person is in a proximity to said guarded passageway; and

access control means responsive to detection of the first control signal and the second control signal for producing a first alarm condition when the infrared field and the receiver means simultaneously detect the selected person at the guarded passageway, said access control means producing a second alarm condition when the infrared field detects a person passing through the guarded passageway without said transmitter unit.

2. Apparatus according to claim 1 in which said first electrical control signal is produced in response to sensing infrared energy from the body of any person passing through the infrared energy field.

3. Apparatus according to claim 2 including an infrared energy source adapted for positioning above the passageway and focusing means for controlling energy emitted from the infrared source to produce a narrow screen of infrared energy across the volume within said guarded passageway.

4. Apparatus according to claim 1 including a pair of receivers adapted from mounting on opposite sides of the passageway, and isolation means for detecting identification signals from either or both receivers for producing said second electrical control signal.

5. Apparatus according to claim 1 including mode switch means for selectively adjusting operation of the access control means to produce an alarm in response to either the first alarm condition or the second alarm condition.

6. Apparatus according to claim 5 including security override means for producing the alarm only upon sensing of a person within said infrared field.

7. Apparatus according to claim 1 including means for providing a coded input signal to reset the access control means after activation of the alarm signal.

8. Apparatus according to claim 1 in which the transmitter unit and receiver means operate on radio frequency within a selected frequency range.

9. Apparatus according to claim 8 in which the transmitter and receiver have an operating frequency of about 480 kHz and an operating range of about two feet or less.

10. A multi-mode access alert monitoring system for detecting and identifying when a first group of persons pass through a guarded passageway in a controlled space and for detecting and identifying when a second group of persons pass through the guarded passageway, the system comprising:

means for producing a narrow field of infrared energy across the guarded passageway;

means for producing a first control signal when the body of a person passing into said infrared energy field is detected;

a portable transmitter unit for emitting an identification signal;

receiver means adapted for mounting adjacent the guarded passageway for detecting the identification signal and producing a second control signal when a person carrying the receiver means is in close proximity to the guarded passageway;

access control means for receiving said first and second control signals to produce an alarm signal identifying a selected access condition depending upon a selected preset access mode; and

access mode switching means for presetting the mode of operation of the access control means, comprising (a) an admit mode for causing simultaneous detection of the first and second control signals by the access control means to produce said alarm signal to activate an alarm to indicate that a person from said first group carrying said transmitter unit has passed through the guarded passageway, and in which said alarm

is inhibited when a selected person from the second group sensed by the infrared field is not carrying said transmitter unit; and (b) a reject mode for causing simultaneous detection of the first and second control signals by the access control means to inhibit activation of the alarm when a person from the second group carrying the transmitter unit passes through the guarded passageway, and in which said alarm signal is activated when a person from the first group sensed by the infrared field is not carrying said transmitter unit.

11. Apparatus according to claim 10 including security override means to produce an alarm only upon sensing of a person by the infrared field.

12. Apparatus according to claim 10 including an infrared energy source adapted for positioning above the passageway and means for focusing the energy admitted from the infrared source to produce a narrow fan beam of infrared energy across the area within the guarded passageway.

13. Apparatus according to claim 10 including means for producing a coded input signal to reset the access control means after activation of the alarm signal.

14. Apparatus according to claim 10 in which the transmitter unit is portable and produces a radio frequency signal within a frequency range of about 480 kHz.

15. An access alert monitoring system for controlling the freedom of movement of persons in a first group and persons in a second group to access areas within a controlled space having a guarded passageway between said access areas, the system comprising:

a plurality of portable transmitter units carried by persons in the first group for emitting a low range identification signal; and

a control unit adapted from mounting adjacent a selected passageway to be guarded, the control unit including means for producing a narrow field of infrared energy across the guarded passageway; means for producing a first electrical control signal when the body of a person passing into said infrared energy field is detected; receiver means adapted for mounting adjacent each of said guarded passageways for detecting said identification signals from the transmitter units and producing a second control signal when a person in the first group is in proximity to the guarded passageway; and access control means responsive to simultaneous detection of said first and second control signals for activating an alarm in said control unit to indicate that a person in the first group has passed through the guarded passageway, said access control means inhibiting activation of said alarm signal when a person in the second group not carrying of said transmitter unit is detected by said infrared energy field.

16. Apparatus according to claim 15 in which each control unit further includes a mode selection means comprising:

(a) an admit mode for causing simultaneous detection of the first and second control signals by the access control means to produce said alarm signal to activate an alarm to indicate that a person from said first group carrying said transmitter unit has passed through the guarded passageway, and in which said alarm is inhibited when a selected person from the second group sensed by the infrared field is not carrying said transmitter unit; and

(b) a reject mode for causing simultaneous detection of the first and second control signals by the access control means to inhibit activation of the alarm when a person from the second group carrying the transmitter unit passes through the guarded passageway, and in which said alarm signal is activated when a person from the first group sensed by the infrared field is not carrying said transmitter unit.

17. Apparatus according to claim 16 including reset means adjacent each guarded passageway for providing a coded input signal to reset the access control means after activation of the alarm signal.

18. A multi-spectrum method for controlling access to areas within a controlled space having at least one guarded passageway, comprising the steps of:

producing a narrow invisible detection screen across the guarded passageway;

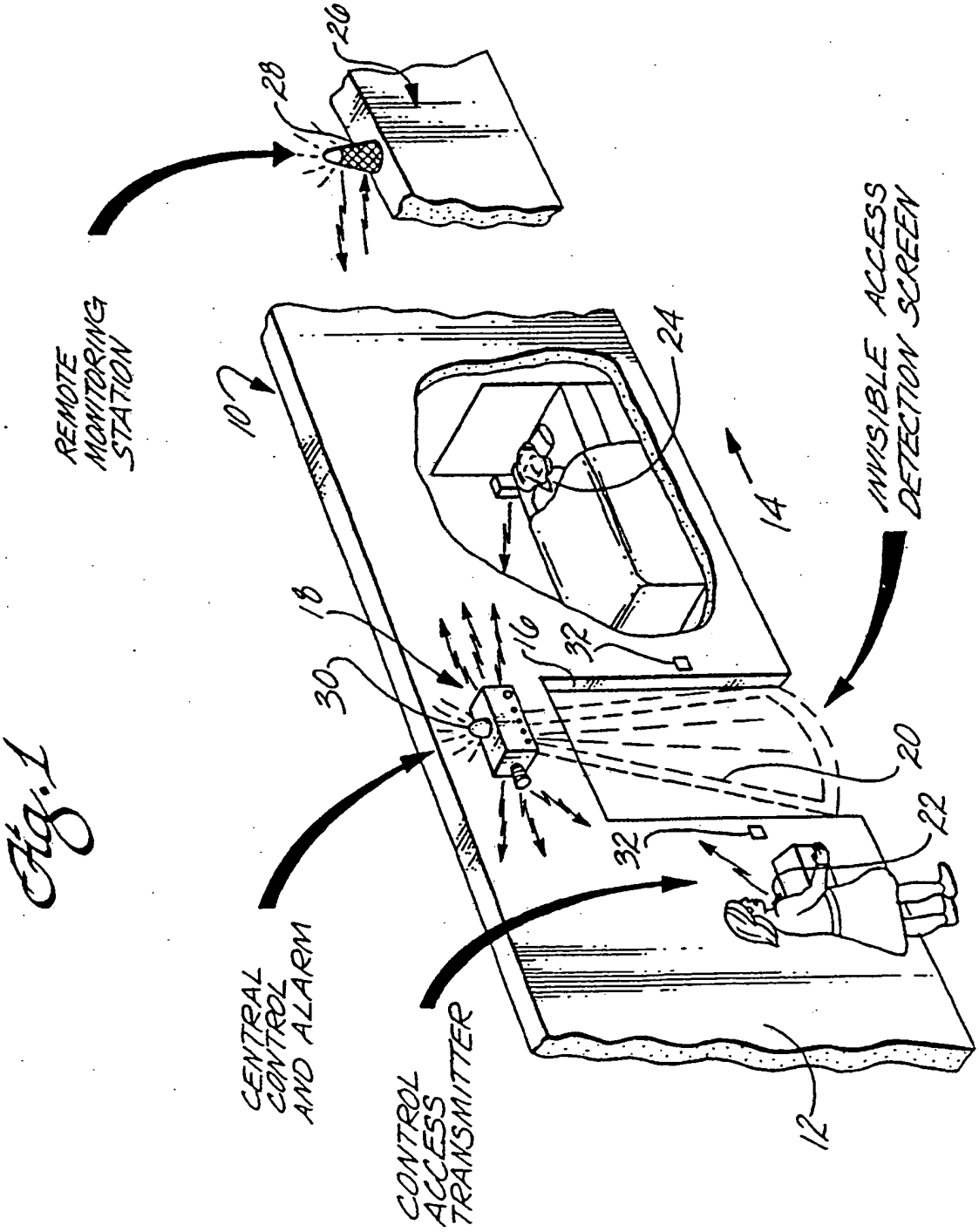
detecting when the body of a person passes into said detection screen and producing a first control signal in response thereto;

providing a portable transmitter for

generating an identification signal, said transmitter to be carried by a person whose passage through the guarded passageway is to be controlled;

placing a receiver adjacent the guarded passageway for detecting the identification signal and producing a second control signal when a person carrying the transmitter unit is in proximity to the guarded passageway; and

providing an access control unit associated with the passageway to produce a first indication of controlled passage through the guarded passageway in response to simultaneous detection of said first and second control signals, while providing an alternate second indication of controlled passage through the guarded passageway in response to the first control signal being generated by a person not carrying said transmitter unit.


REMOTE MONITORING STATION
CENTRAL CONTROL AND ALARM
CONTROL ACCESS TRANSMITTER
INVISIBLE ACCESS DETECTION SCREEN
10
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32
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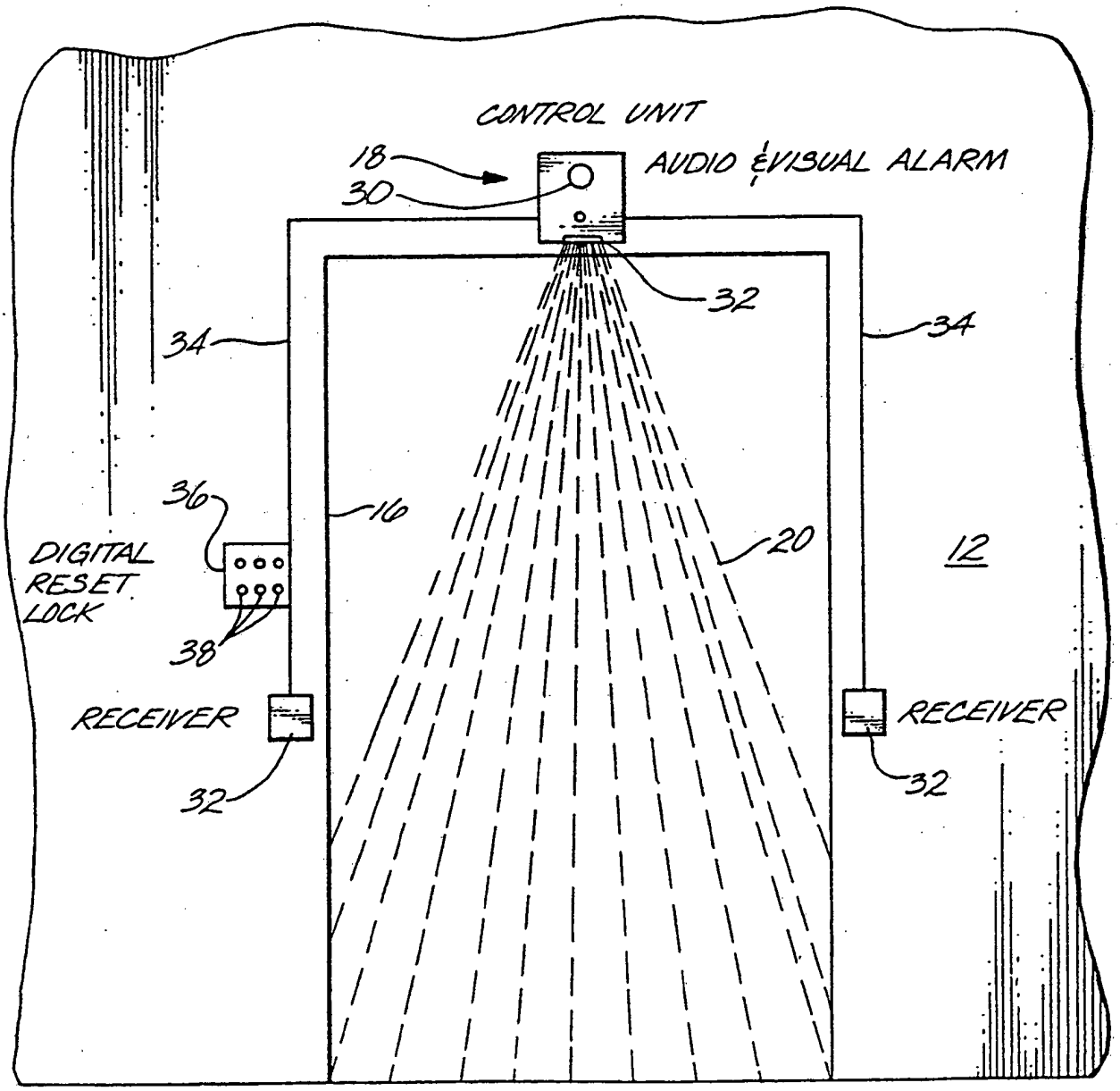
Fig. 1

Fig. 2


CONTROL UNIT
18
AUDIO & VISUAL ALARM
30
32
34
34
36
16
20
12
DIGITAL
RESET
LOCK
38
RECEIVER
RECEIVER
32
32

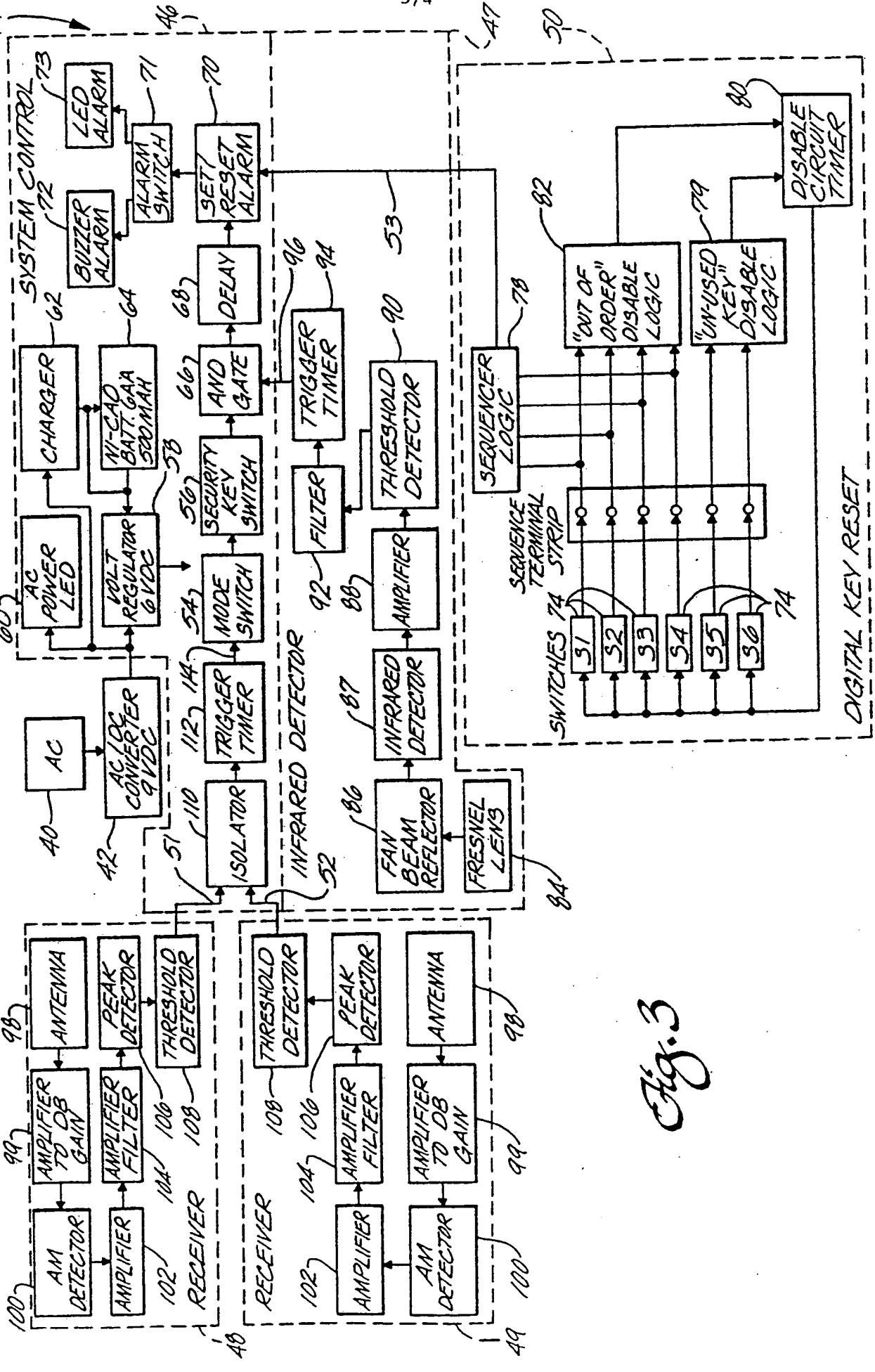

SYSTEM CONTROL
INFRARED DETECTOR
DIGITAL KEY RESET
RECEIVER
RECEIVER
AC
AC/DC CONVERTER 9 VDC
AC POWER LED
VOLT REGULATOR 6 VDC
CHARGER
NI-CAD BAT. 6AA 500MAH
BUZZER ALARM
LED ALARM
ALARM SWITCH
SET RESET ALARM
DELAY
AND GATE
TRIGGER TIMER
THRESHOLD DETECTOR
AMPLIFIER
FILTER
SECURITY KEY SWITCH
MODE SWITCH
TRIGGER TIMER
ISOLATOR
INFRARED DETECTOR
AMPLIFIER
FAN BEAM REFLECTOR
FRESNEL LENS
SEQUENCER LOGIC
"OUT OF ORDER" DISABLE LOGIC
"UN-USED KEY" DISABLE LOGIC
DISABLE CIRCUIT TIMER
SEQUENCE TERMINAL STRIP
SWITCHES 74
S1
S2
S3
S4
S5
S6
ANTENNA
PEAK DETECTOR
THRESHOLD DETECTOR
AMPLIFIER 70 DB GAIN
AMPLIFIER FILTER
AM DETECTOR
AMPLIFIER
ANTENNA
PEAK DETECTOR
THRESHOLD DETECTOR
AMPLIFIER FILTER
AMPLIFIER 70 DB GAIN
AM DETECTOR
AMPLIFIER
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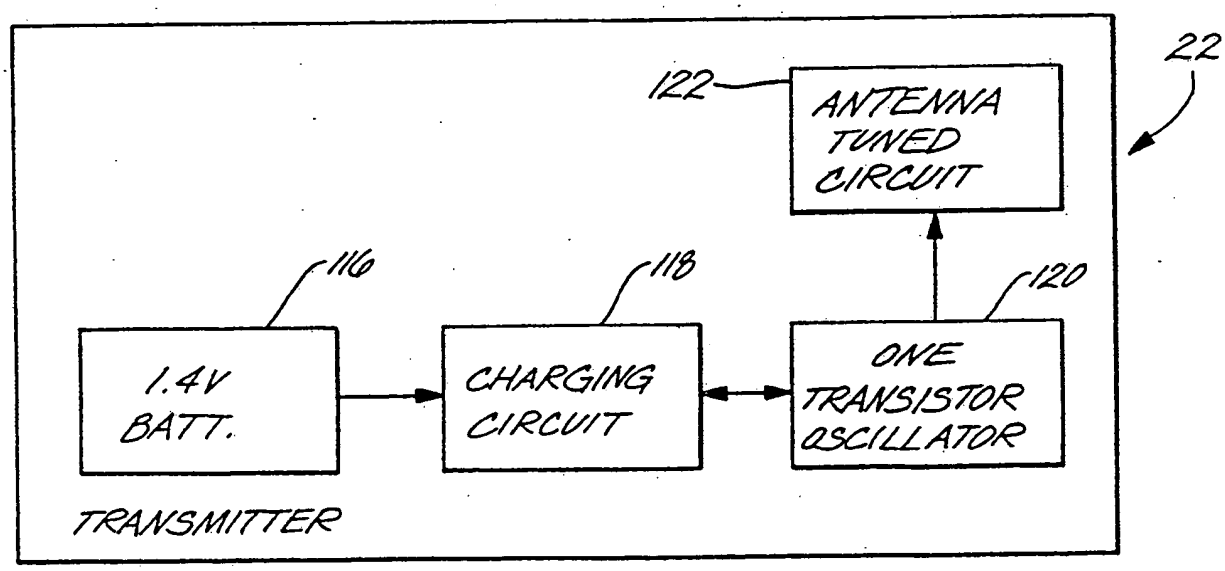
Fig. 3

Fig. 4


22
122
ANTENNA TUNED CIRCUIT
116
118
120
1.4V BATT.
CHARGING CIRCUIT
ONE TRANSISTOR OSCILLATOR
TRANSMITTER

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US88/03721

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(4): G08B 23/00, 19/00
U.S. CL. 340/573; 340/522

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	340/573, 572, 567, 545, 522; 455/100

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	US, A, 4,684,933 (DILL) 04 AUGUST 1987 See column 2, line 59 to column 3, line 11.	1-4,7-9,15,18
Y	US, A, 4,682,155 (SHIRLEY) 21 JULY 1987 See column 3, lines 62-66 and column 4, lines 60-64.	1-4,7-9,15,18
Y	US, A, 4,660,024 (McMASTER) 21 APRIL 1987 See column 2, lines 34-45.	1-4,7-9,15
Y	US, A, 4,590,460 (ABBOTT ET AL.) 20 MAY 1986 See column 2, lines 44-52.	3

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

13 DECEMBER 1988

Date of Mailing of this International Search Report

02 FEB 1989

International Searching Authority

ISA/US

Signature of Authorized Officer

Thomas J. Mullen, Jr.

Form PCT/ISA/210 (second sheet) (Rev.11-87)